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ABSTRACT

This document describes the FAMILY MATH course which has been developed to teach parents how to help their children learn mathematics. The goals of the program are to: (1) provide parents with activities to help their children with mathematics at home; (2) provide parents with information about the importance of mathematics in future schooling and work; (3) inform families about the equity issues around mathematics; (4) inform parents that mathematics is important for all students; (5) build awareness that mathematics consists of more than arithmetic and rote computations; (6) develop problem-solving skills and the ability to talk about mathematics; (7) build positive attitudes toward mathematics; (8) help parents feel that they can and do make a difference in their children's mathematics education; and (9) provide an opportunity for all members of the family. The document includes results of a survey of class participants, sample materials, a description of the evolution of the project, and projections of future activities. (PK)

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*FAMILY MATH: A Report of an Intervention Program that Involves Parents in their Children's Mathematics Education**

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Introduction

"How can I help my child with math at home?"

"What role will math play in my child's future schooling and work?"

"Is it possible to have fun with math?"

Thousands of parents are discovering the answers to these questions in classes around this country and in Australia. A program, based at the Lawrence Hall of Science (University of California , Berkeley) called FAMILY MATH is teaching them how to help their children learn mathematics. Many parents would like to help their children, but they just don't know how to begin. Stop and think. When we want to help children with reading, there are lots of things we can do: read to them, look at picture books, go to the library--all fun and enjoyable. What about helping with math? All most of us can think of is to help our children learn the multiplication tables by using flash cards or insist that they do their homework **before** they go out to play.

A FAMILY MATH course taught by a teacher, parent, or community worker in a school, church, or home, gives parents, together with their children, opportunities to develop their problem-solving skills and to understand mathematical concepts in areas that reinforce and supplement the school mathematics curriculum. The classes provide a setting for families to enjoy doing mathematics together. In addition, the families have the opportunity to meet women and men from the community who are working in math-based fields and learn about the importance of mathematics to future education and work.

FAMILY MATH might well be called a daughter of the EQUALS project, which is also based at the Lawrence Hall of Science. For the last nine years, this project has presented inservice workshops for K-12 teachers addressing the issue: How can we encourage **all** students to continue with mathematics when it becomes optional. In particular, how can we reach and encourage those students who have been, traditionally, the first to drop out--our Black, Hispanic, and Native American students, and females

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of all races. We knew from experience with EQUALS, and research (Kreinberg, 1981; Beane, 1985) confirms this experience, that students who are not encouraged to persist in mathematics, who do not see the relevance of math to their future lives, and who are not confident about their abilities to be successful in mathematics are the ones most likely to drop out of mathematics once it becomes optional. Their lack of preparation in mathematics will lead to severely reduced options for them in the workforce or higher education.

Our EQUALS teachers reminded us of the important role that the parents can play in encouraging their children to continue with mathematics. We felt that, if we could immerse both parents and their children in learning mathematics, provide a supportive enviornment, model a teaching style that encourages persistence in problem-solving, while covering important math topics, we might make a postive impact on those students who are particularly "at risk."

FAMILY MATH Classes

In 1981, we wrote for and received a grant from FIPSE (the Fund for the Improvement of Postsecondary Education) to develop and pilot test FAMILY MATH courses. Our pilot courses were taught by grade levels (K-1, 2-3, 4-6, 7-8) in low socio-economic areas of Richmond and Oakland, California. They met two hours a week for four to six weeks. Parents and their children came to learn activities from areas such as arithmetic, measurement, geometry, probability and statistics, estimation and the appropriate use of calculators, and logical thinking--all topics from the K-8 mathematics curriculum. Instructions and materials were sent home with the families so that the activities could be continued outside the course. Parents were given overviews of the mathematics topics covered at their children's grade levels and explanations of how the FAMILY MATH activities related to these topics. In addition, one evening, or parts of several evenings, were devoted doing activities that provided information about the mathematics requirements in higher education and on the job. The older students and their parents also heard a role model panel. These panels consisted of students from their community majoring in math-based fields at a nearby college or men and women from the community working in such fields.

As we taught these classes, we evolved a set of goals for FAMILY MATH, which might be summarized as follows. We wanted :

*to provide parents with activities to help their children with mathematics at home;

*to provide parents information about the importance of mathematics in future schooling and work;
*to inform families about the equity issuses around mathematics;
*to inform parents that mathematics is important for **all** students;
*to build awareness that mathematics consists of more than arithmetic and rote computations;
*to develop problem-solving skills and the ability to talk about mathematics;
*to build positive attitudes toward mathematics;
*to help parents feel that they can and do make a difference in their children's mathematics education;
*to provide an opportunity for all members of the family to enjoy doing mathematics.

Perhaps our overall goal is that we want families to go away from classes and continue to do mathematics activities at home so that the children see that their parents value the subject and these problem-solving approaches to it; and in turn that these experiences will help the children to persist when the going gets hard and mathematics becomes an optional course at school.

Follow-up questionnaires returned by 38 parents (response rate of 6l%), who attended FAMILY MATH classes in our first year, showed a high level of math-related activity undertaken by FAMILY MATH participants. Over 34 (approximately 90%) of the respondents played math games with their children and helped with math homework; 80% talked about everyday math in news articles and the like, and a similar proportion talked to their children's teachers about mathematics. Nineteen of the respondents talked with their children about jobs and careers, and the same number had aquired a math puzzle or book for their children. One parent reported that she was convinced that FAMILY MATH caused her son's math grade to rise from a D to a B-.

Parents also took actions for themselves, including getting a math puzzle or book (50%), a math refresher book (27%), and taking another math class (18%). Most (72%) said they learned to teach math to their children in a new and fun way, and that the FAMILY MATH activities coordinated with what was happening at their children's schools. One third of the respondens reported that they had learned some mathematics from the course.

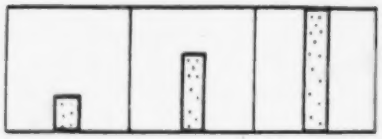
To give you more of a feel of how a FAMILY CLASS would work and why we choose certain activities and how we present them, let us turn now to two activites: Double Digit and Balloon Ride (see pages 4 and 5). Read over the directions for Double Digit, find some scratch paper, a die, and a friend or two and play several rounds. Be sure to remember that you

Double Digit

Why

To practice place value and estimation skills

Both skill and chance play important roles in this game. The dice rolls make it difficult to use a consistent winning strategy. However, an intuitive understanding of probability, or what usually happens, will allow children to find a strategy that will be successful more often than not. Development of estimation skills will increase a child's chances for success in other areas of mathematics.



Grade Level

TOOLS

Pencil
Paper for scoresheets
Dice

A game for
2-6 players

How

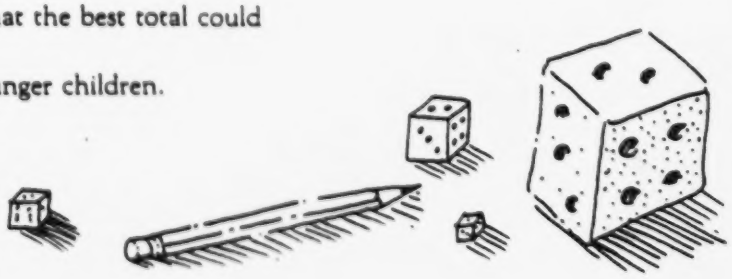
- You will need one die for the group and a scoresheet for each person in your family, like this one:

TENS	ONES
1.	
2.	
3.	
4.	
5.	
6.	
7.	

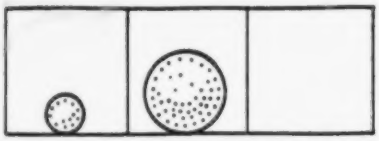
- Each person takes a turn rolling the die.
- The number may be written in either the tens' column or the ones' column of the scoresheet.
  - When a number is entered in the tens' column, "0" is written next to it in the ones' column. Thus, 4 written in the tens' column counts as 40.
- After each player has rolled the die **seven** times, the players add up their numbers.
- The players who are left in the game compare their totals.
- The player who is closest to 100 without going over is the winner.

More Ideas

- At the end of the game, talk about what the best total could have been with those seven rolls.
- See also the game Dollar Digit, for younger children.



Balloon Ride



Grade Level

TOOLS

10 or more toothpicks
Balloon Ride board

A game for
2 players

Why

To practice problem-solving techniques by trying to figure out how to win a variation of the old Chinese game of NIM

How

- Tell the children a story about the hot air balloon coming to town. There is a contest to win a free ride. There are ten ropes holding the balloon to the ground. Two people take turns cutting the ropes. Each person may cut either **one** or **two** ropes. The person who cuts the last rope wins a free ride.
- Put out ten toothpicks on the Balloon Ride board to represent the ropes.
- Players take turns picking up one or two toothpicks at a time.
- No one is allowed to skip a turn.
- The person who takes the last one (or two) toothpicks wins the free ride.

► *When you and your child begin to see some patterns and possible strategies, see if together you can work out a way to win every time. (Hint: Start with a game that has just a few toothpicks. Who has the best chance of winning? Then add a few more toothpicks. This is called working backward.)* ◄

More Ideas

- After you think you have found a way to win, use a larger number of toothpicks—maybe twelve or nineteen.
- You can also change the number of toothpicks that can be picked up—try picking up one, two, or three toothpicks on each turn.
- You may even want to change the rules so that the person who has to pick up the last toothpick is the **loser** instead of the winner.

► *This activity develops intuitive understanding of subtraction or "take-away." If children can find a strategy to win, it will build a stronger number sense.* ◄

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must take all seven turns and that the goal is to have a total as close to 100 as possible, **without** going over 100. After you have played a while, discuss any strategies that you have devised with your friends. Try a few more rounds and then discuss what kinds of mathematics you have been using.

A list of topics mentioned at a typical FAMILY MATH class might include addition, subtraction, estimation, and mental arithmetic. There is another math topic that you have been using that is often omitted on such a list, especially if Double Digit is one of the first activities presented to the class--and that is probability theory. As they play, most people use the knowledge that when you roll a regular die each of the number is equally-likely to turn up; that is, a six, say, won't turn up more frequently just because it is a larger number. The addition of probability to the list presents the opportunity to discuss the changes that have taken place in the elementary mathematics curriculum in the past years.

Think back to the mathematics you learned in elementary school. What topics do you remember? Addition, subtraction, multiplication, division, fractions, decimals, per cent, and maybe some measurement? Today's curriculum contains more topics. It includes not only arithmetic, but measurement, informal geometry, probability and statistics, recognizing patterns and relationships, logical thinking, and the appropriate use of calculators and computers in all areas of mathematics. Indeed, many of the concepts from these latter topics are less complicated than those algorithmns we teach in arithmetic. FAMILY MATH classes present activities from all areas of the curriculum, in order to introduce parents to the new topics and help all members of the family to understand that mathematics is more than arithmetic.

Now let's turn to the Balloon Ride (page 5), which is an excellent example of what we mean by a logical thinking activity. Read over the rules and find a friend to play with. After several games, stop discuss with your partner how you might always win. When in the game do you know you are going to lose? Can you find any patterns? Can you work backwards to find a strategy for winning, starting with ten toothpicks?

If you were in a FAMILY MATH class when you first learned the above activities, you would notice a lot of noise. People would be talking about mathematics, explaining their ideas, making and testing hypotheses, and laughing. In order to get their attention, the instructor would have to ask them to stop talking about mathematics. How often these families been asked to stop talking about math? What is exciting about this situation is being able to explain one's ideas: a very important skill in mathematics which is not given enough time in the school classroom. Here parents and

their children have the opportunity to develop this ability and to learn its importance.

Balloon Ride and Double Digit should give you a sense of the type of activities that are taught in FAMILY MATH classes. What we look for are activities that are problem-solving in nature, that is, activities that require thought as opposed to answers that are based on memorizing. We want these activities to be of enough interest that they will continue to be used after the families go home, and we want the materials for them to be inexpensive every-day items, so that cost will not hinder their use. When we present inservices, we teach activities from our *FAMILY MATH* book (Stenmark, Thompson, and Cossey, 1986), but we also encourage the future FAMILY MATH instructors to look for activities with these characteristics from their own experience to use in their courses.

The evaluation data mentioned above indicate that our pilot classes were successful. We feel that some of the characteristics that contributed to this success are the following:

We provide a **supportive environment** in which children and their parents, who often come to the classes with a great dislike for mathematics, are comfortable doing mathematics. This environment is nonthreatening, while it encourages the risk-taking involved in developing good problem-solving skills.

The **mathematics content** is presented in a way that explains how the concepts children are taught are interrelated, and why the learning is important. Regardless of the topics taught, the use of activity-based materials facilitates better understanding of the concepts. Parents learn activities to use at home that reinforce the concepts being taught at school. We present familiar topics first, such as arithmetic, and gradually introduce unfamiliar topics and approaches so that curiosity is piqued and motivation to solve problems is encouraged.

We model a **teaching style** that we hope parents will adopt with their children, which includes providing early success so that learners will want to continue; activities and their extensions that can be done at home without becoming boring; and enthusiasm for math learning and positive attitudes toward persisting to complete challenging problems.

The **link to careers and the future** is introduced through role models and career-based activities. To ensure that the *reason* for studying mathematics is clear, men and women working from the community in math-based jobs or students, who grew up in the community and are majoring in math-based fields, talk about how math is used in their jobs or studies. They also discuss how and why they chose their fields of interest and what role their parents played in helping them attain their goals. These role models can be extremely important for children who are beginning to think that they will never use math as the rock star

or professional athelete they expect to become. This component can include older members of the family, so that the whole family can continue to participate in these discussions at home.

Dissemination

As we were finishing our second year of pilot classes, we began to receive requests for inservices about FAMILY MATH. In February 1983, an informal session was presented for a principal and part of her staff. Later in July of that year, we gave a six-hour session that included discussions of our philosophy and goals for FAMILY MATH, how to start a class, what and how to teach, and an opportunity to try a number of activities. We found that a one-day training was not long enough to cover all of the material; consequently, we developed a two-day inservice for subsequent trainings.

After staff development training, several areas are now presenting their own FAMILY MATH inservices. Among these are: the San Diego County Office of Education; Tri-County Math Project (Santa Barbara, CA); Consortium for Educational Equity at Rutgers; Valle del Sol (a community-based organization in Phoenix, Arizona); two EQUALS sites in Portland, Oregon and Charlotte, North Carolina, as well as the FAMILY MATHS Project, in Melbourne, Australia. All told, the inservice program has been presented to 2,300 people who have given over 600 classes for 7,500 families, or 15,000 parents and their children.

In 1984, we received funding from the Women's Education Equity Act Program to produce a 17-minute color documentary film entitled *We All Count in FAMILY MATH.* This has enabled us to give thousands of people a look at what actually goes on in FAMILY MATH classes and how some families are using the ideas and materials.

As part of our FIPSE project we prepared a manuscript for the *FAMILY MATH* book to document our activities and explain how to set up FAMILY MATH classes. With assistance from the Carnegie Corporation, the book was published this spring. It is written for parents to use with their children at home, as well as to be a guide for FAMILY MATH instructors.

SUMMARY

We began FAMILY MATH with a particular concern about inner-city and low-income communities; we were not prepared for the response to this program from *all* kinds of communities. Certainly our nine years of experience in presenting our EQUALS workshops helped us develop a sound

inservice program. We have used the FAMILY MATH film and book in our inservices to convey the philosophy and important points to others who wish to conduct FAMILY MATH courses in their own communities. FAMILY MATH instructors understand the importance of creating a supportive, nonthreatening atmosphere in their classes where parents and children can succeed in doing mathematics.

We have found that the FAMILY MATH materials work with children from preschool through high school, and adults from diverse ethnic and socio-econonic backgrounds. For example, the "Balloon Ride" activity is challenging for four-year-olds and forty-year-olds. The reason for this success is that the materials are activity-oriented and "hands-on"; the learner is manipulating objects in a problem-solving way, seeking a solution not based on previously memorized knowledge, but on talk and actions during the activity. A number of professional mathematicians have been involved in our program and all of them have been commented on the soundness of the mathematics we are teaching and the pleasant way in which it is being taught. FAMILY MATH instructors also comment on the ease of use of the materials, and there is no doubt that the parents and children who attend the classes enjoy the activities.

Because we present the materials in our workshops for potential leaders and trainer-of-trainers in the same way that we want them taught in classes, we find that the instructors feel very well prepared to teach the classes, and we get few phone calls or letters requesting major assistance. We do, however, receive many phone calls from instructors inquiring about new materials, activities, or resources they can use.

FAMILY MATH instructors tend to prepare and teach more complicated classes than we did during our first two years; they usually draw on a variety of materials they have acquired and do not limit themselves to the activities they learned in FAMILY MATH. Ownership becomes an important factor in FAMILY MATH, and we tend to see classes that vary considerably in size, grade levels, and materials presented over time.

In some areas, recruitment is too easy and FAMILY MATH instructors must be prepared to limit class size or be overwhelmed. (One instructor had as many as 100 families sign up for a class!) In other areas, recruitment is the major challenge of presenting a course. The most successful recruitment efforts, overall, are those in which the student's classroom teacher or aide is involved with FAMILY MATH. In most cases, the teacher sends a notice about the class home, followed by a reminder notice shortly before the class begins. Some instructors choose to inform and invite parents during parent conferences or back-to-school nights.

Others might visit several math classes in a school, do a FAMILY MATH activity, and invite students to bring their parents to a FAMILY MATH class. Some schools have put on one-night introductions to the program in the spring as a recruitment for the fall. The methods vary according to the location. However, they are most successful are when the recruiter is known in the community. In general, even if the recruitment has been difficult, once the parents come, they tend to come back.

Perhaps another major reason for the project's good reception is the fact that, although parents have known what to do to help their children in areas such as reading, there has been a dearth of materials or ideas for helping their children with mathematics. The only thing parents knew to do was try to teach their children as they were taught, which all too often was in an unpleasant and unthinking manner. FAMILY MATH has been able to provide parents with materials to help their children with mathematics in an enjoyable manner. There is no question that parents are grateful and appreciative of this. In turn, those who teach FAMILY MATH after an inservice receive this appreciation from the parents they work with and they are excited to contine the program. Notes from a FAMILY MATH instructor from Livermore, California, reflect some of the impact or the program for her:

> *I had each family keep a log book which I collected and returned (after reading)... By way of summary, I asked families to make log entries of favorite and least favorite activities, suggesions on class operations--what to add, change, keep the same, etc. ... "Some suggestions offered were: "Fewer activities per session; less philosophy to parents and more time to play games; classes in other subject areas for parents and children." Among comments that parents made about the value of the class were: "Great estimating concepts; super awareness of everyday math skills; parent is able to see where child is in math; child has a special time with parent; math can be fun; the wealth of new materials you gave us was fantastic."*
>
> *I did my own thing--I compiled things from FAMILY MATH, the Bay Area Math Project, and my own resources. I might just offer a version to my own first grade class and parents next year--the results were so dramatic for the 26 who participated as opposed to the 6 who didn't that I'm sure the effects came through on CTBS testing and I want to keep that going...At our recent School Improvement Program*

Review the site administrator proudly pointed to FAMILY MATH as part of our Parent Education component and took credit for facilitating it...

As far as what I learned...I learned so much about the kids in my class as I watched them interact with their parents. A new rapport between parents and myself was established--Dads especially. We became friends more freely and mutual respect was fostered. Parents too grew in their math abilities; they enjoyed themselves, and learned about how they learned math, and how to gear it to their children, as well as finding out where their child was academically. There was a great carryover into the classroom--math esteem grew and test scores climbed for all who participated more rapidly than those who did not take part.

Another instructor wrote:

Teaching FAMILY MATH to parents and children has been one of the most rewarding experiences I have had in my twenty-one year teaching career.Our response was so successful that were able to offer both a K-3 and a 4-6 course... I have had wonderful support from within the school, the district, the parents and the community. We were able to use some monies from our SIP program to purchase a classroom set of calculators... =The local newspaper gave us a wonderful "spread," we even hit the front page! The parents and children have been most enthusiastic and have helped interest other families in future sessions. The materials given us at the FAMILY MATH training have been most useful.

What does the future look like for FAMILY MATH? We have received a grant from the National Science Foundation to help establish FAMILY MATH inservices and classes in cooperation with community-based organizations in minority neighborhoods. Our first site is at Valle del Sol, an Hispanic organization, in Phoenix, Arizona. The NSF funding will also allow us to do a more in-depth evaluation of the effects of the program on parent interactions with their children and their schools, and to translate the FAMILY MATH materials into Spanish. We will extend this program to Oregon and Indianapolis, working with the Oregon Indian Education Association and the National Urban League in these locations.

In response to suggestions from parents and instructors, we are working with colleagues in Oregon and North Carolina to develop FAMILY

SCIENCE and FAMILY COMPUTING programs. And we are working with the National Urban Coalition on their new *Say Yes to a Youngster's Future* project. All of these efforts will help in bringing FAMILY MATH to more people throughout the country.

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